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THE FUNCTIONS AND USES OF FOOD.[a]

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In this circular a number of the terms used in discussing food are defined and some of the principles of nutrition are briefly stated. The average composition of a number of the more common American foods is quoted as well as the commonly accepted dietary standards. With the aid of such data, the nutritive value of any given diet may be computed and its comparative value ascertained. The method of making such calculations is given, as is also a method for calculating the digestibility of different foods.

Ordinary food materials, such as meat, fish, eggs, potatoes, wheat, etc., consist of "refuse" and "edible portion."

Refuse includes the bones of meat and fish, shells of shellfish, skins of potatoes, bran of wheat, etc.

Edible portion includes the flesh of meat and fish, the white and yolk of eggs, wheat flour, etc. The edible portion consists of water and nutritive ingredients, or nutrients. The nutritive ingredients are *protein*, *fats*, *carbohydrates*, and *mineral matters* or *ash*.

The water, refuse, and salt of salted meat and fish are called non-nutrients. In comparing the values of different food materials for nourishment they are left out of account.

USE OF NUTRIENTS.

Food is used in the body to build and repair tissue and to furnish energy. The manner in which the valuable constituents are utilized in the body may be expressed in tabular form as follows:

Protein White (albumen) of eggs, curd (casein) of milk, lean meat, gluten of wheat, etc.	Forms tissue (muscles, tendon, and probably fat).	All serve as *fuel* and yield *energy* in form of heat and muscular strength.
Fats Fat of meat, butter, olive oil, oils of corn and wheat, etc.	Form fatty tissue.	
Carbohydrates Sugar, starch, etc.	Transformed into fat.	
Mineral matters (ash) Phosphates of lime, potash, soda, etc.	Aid in forming bone, assist in digestion, etc.	

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[a] This article, which was originally published under the title "Food for Man" in the U. S. Dept. Agr. Yearbook, 1897, pp. 676-682, has been revised and contains some additional matter.

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The chief uses of food, then, are two: (1) To form the material of the body and repair its wastes, and (2) to yield heat to keep the body warm and furnish muscular and other power for the work it has to do. In forming the tissues and the fluids of the body the food serves for building and repair. In yielding heat and power it serves as fuel.

If more food is eaten than is needed, more or less of the surplus may be and sometimes is stored in the body, chiefly in the form of fat. The fat in the body forms a sort of reserve supply of fuel and may be burned by the body in the place of food. When the work is hard or the food supply is low, the body draws upon this store of fat and grows lean.

In a sense, the body is a superior machine. Like other machines, it requires material to build up its several parts, to repair them as they are worn out, and to serve as fuel. In many respects it is analogous to a steam engine, although one important difference between the human machine and the steam engine is that the former is self-building, self-repairing, and self-regulating. Another is that the material of which the engine is built is very different from that which it uses for fuel, but part of the material which serves the body for fuel also builds it up and keeps it in repair. Furthermore, the body can use its own substance for fuel. This the steam engine can not do.

The fuel value of food.—Heat and muscular power are forms of force or energy. The energy is developed as the food is consumed in the body. The unit commonly used in this measurement is the calorie, the amount of heat which would raise the temperature of a pound of water 4° F.

Instead of this unit some unit of mechanical energy might be used—for instance, the foot-ton, which represents the force required to raise 1 ton 1 foot. One calorie is equal to very nearly 1.53 foot-tons.

The following general estimate has been made for the average amount of potential energy in 1 pound of each of the classes of nutrients:

	Calories.
In 1 pound of protein	1,814
In 1 pound of fats	4,037
In 1 pound of carbohydrates	1,814

In other words, when we compare the nutrients in respect to their fuel values, their capacities for yielding heat and mechanical power, a pound of protein of lean meat or albumen of egg is just about equivalent to a pound of sugar or starch, and a little over two pounds of either would be required to equal a pound of the fat of meat or butter or the body fat.

Within recent years analyses of a large number of samples of foods have been made in this country. The average results of a number of these analyses are given in the table following.

Average composition of American food products.[a]

Food materials (as purchased).	Refuse.	Water.	Protein.	Fat.	Carbohydrates.	Ash.	Fuel value per pound.
ANIMAL FOOD.							
Beef, fresh:	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Cals.*
Chuck, including shoulder	17.3	54.0	15.8	12.5	....	0.7	791
Chuck ribs	19.1	53.8	15.3	11.1	....	.8	726
Flank	5.5	56.1	18.6	19.9	....	.8	1,141
Loin	13.3	52.9	16.4	16.9	....	.9	980
Porterhouse steak	12.7	52.4	19.1	17.9	....	.8	1,069
Sirloin steak	12.8	54.0	16.5	16.1	....	.9	949
Neck	31.2	45.3	14.2	9.2	....	.7	629
Ribs	20.1	45.3	14.4	20.0	....	.7	1,069
Rib rolls	....	64.8	19.4	15.5	....	.9	978
Round	8.5	62.5	19.2	9.2	....	1.0	720
Rump	19.0	46.9	15.2	18.6	....	.8	1,027
Shank, fore	38.3	43.2	13.2	5.2	....	.6	449
Shoulder and clod	17.4	57.0	16.5	8.4	....	.9	638
Fore quarter	20.6	49.5	14.4	15.1	....	.7	871
Hind quarter	16.3	52.0	16.1	15.4	....	.8	914
Beef, corned, canned, pickled, and dried:							
Corned beef	8.4	49.2	14.3	23.8	....	4.6	1,220
Tongue, pickled	6.0	58.9	11.9	19.2	....	4.3	991
Dried, salted, and smoked	4.7	53.7	26.4	6.9	....	8.9	757
Canned boiled beef	....	51.8	25.5	22.5	....	1.3	1,371
Canned corned beef	....	51.8	26.3	18.7	....	4.0	1,232
Veal:							
Breast	23.3	52.5	15.7	8.2	....	.8	616
Leg	11.7	63.4	18.3	5.8	....	1.0	566
Leg cutlets	3.4	68.3	20.1	7.5	....	1.0	667
Fore quarter	24.5	54.2	15.1	6.0	....	.7	516
Hind quarter	20.7	56.2	16.2	6.6	....	.8	560
Mutton:							
Flank	9.9	39.0	13.8	36.9	....	.6	1,740
Leg, hind	17.7	51.9	15.4	14.5	....	.8	865
Shoulder	22.1	46.8	13.7	17.1	....	.7	939
Fore quarter	21.2	41.6	12.3	24.5	....	.7	1,212
Hind quarter, without tallow	19.3	43.3	13.0	24.0	....	.7	1,205
Lamb:							
Breast	19.1	45.5	15.4	19.1	....	.8	1,050
Leg, hind	13.8	50.3	16.0	19.7	....	.9	1,086
Pork, fresh:							
Flank	18.0	48.5	15.1	18.6	....	.7	1,025
Ham	10.3	45.1	14.3	29.7	....	.8	1,458
Loin chops	19.3	40.8	13.2	26.0	....	.8	1,289
Shoulder	12.4	44.9	12.0	29.8	....	.7	1,421
Tenderloin	....	66.5	18.9	13.0	....	1.0	868
Pork, salted, cured, and pickled:							
Ham, smoked	12.2	35.8	14.5	33.2	....	4.2	1,603
Shoulder, smoked	18.9	30.7	12.6	33.0	....	5.0	1,561
Salt pork	....	7.9	1.9	86.2	....	3.9	3,514
Bacon, smoked	8.7	18.4	9.5	59.4	....	4.5	2,570
Sausage:							
Bologna	3.3	55.2	18.2	19.7	....	3.8	1,126
Farmer	3.9	22.2	27.9	40.4	....	7.3	2,137
Frankfort	....	57.2	19.6	18.6	1.1	3.4	1,126
Soups:							
Celery, cream of	....	88.6	2.1	2.8	5.0	1.5	242
Beef	....	92.9	4.4	.4	1.1	1.2	116
Meat stew	....	84.5	4.6	4.3	5.5	1.1	357
Tomato	....	90.0	1.8	1.1	5.6	1.5	179
Poultry:							
Chicken, broilers	41.6	43.7	12.8	1.4	....	.7	289
Fowls	25.9	47.1	13.7	12.3	....	.7	745
Goose	17.6	38.5	13.4	29.8	....	.7	1,446
Turkey	22.7	42.4	16.1	18.4	....	.8	1,035
Fish:							
Cod, dressed	29.9	58.5	11.1	.2	....	.8	209
Halibut, steaks or sections	17.7	61.9	15.3	4.4	....	.9	455
Mackerel, whole	44.7	40.4	10.2	4.2	....	.7	355
Perch, yellow, dressed	35.1	50.7	12.8	.7	....	.9	260
Shad, whole	50.1	35.2	9.4	4.8	....	.7	364
Shad, roe	....	71.2	20.9	3.8	2.6	1.5	580
Fish, salt: Cod	24.9	40.2	16.0	.4	....	18.5	306

[a] Condensed from detailed tables in Bulletin No. 28, revised, of the Office of Experiment Stations of this Department.

Average composition of American food products—Continued.

Food materials (as purchased).	Refuse.	Water.	Protein.	Fat.	Carbohydrates.	Ash.	Fuel value per pound.
ANIMAL FOOD—continued.							
Fish, canned:	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Cals.*
Salmon	14.2	56.8	19.5	7.5	....	2.0	657
Sardines	[a]5.0	53.6	23.7	12.1	....	5.3	918
Shellfish:							
Oysters, "solids"	....	88.3	6.0	1.3	3.3	1.1	221
Clams	....	80.8	10.6	1.1	5.2	2.3	331
Crabs	52.4	36.7	7.9	.9	.6	1.5	191
Lobsters	61.7	30.7	5.9	.7	.2	.8	139
Eggs: Hen's eggs	[b]11.2	65.5	13.1	9.3	....	.9	613
Dairy products, etc.:							
Butter	....	11.0	1.0	85.0	....	3.0	3,450
Whole milk	....	87.0	3.3	4.0	5.0	.7	312
Skim milk	....	90.5	3.4	.3	5.1	.7	166
Buttermilk	....	91.0	3.0	.5	4.8	.7	162
Condensed milk	....	26.9	8.8	8.3	54.1	1.9	1,476
Cream	....	74.0	2.5	18.5	4.5	.5	874
Cheese, Cheddar	....	27.4	27.7	36.8	4.1	4.0	2,063
Cheese, full cream	....	34.2	25.9	33.7	2.4	3.8	1,874
VEGETABLE FOOD.							
Flour, meal, etc.:							
Entire-wheat flour	....	11.4	13.8	1.9	71.9	1.0	1,632
Graham flour	....	11.3	13.3	2.2	71.4	1.8	1,626
Wheat flour, patent roller process—							
High-grade and medium	....	12.0	11.4	1.0	75.1	.5	1,610
Low grade	....	12.0	14.0	1.9	71.2	.9	1,623
Macaroni	....	78.4	3.0	1.5	15.8	1.3	402
Crushed wheat	....	10.1	11.1	1.7	75.5	1.6	1,640
Buckwheat flour	....	13.6	6.4	1.2	77.9	.9	1,578
Corn meal	....	12.5	9.2	1.9	75.4	1.0	1,612
Oatmeal	....	7.3	16.1	7.2	67.5	1.9	1,808
Rice	....	12.3	8.0	.3	79.0	.4	1,591
Tapioca	....	11.4	.4	.1	88.0	.1	1,608
Starch	....	....	....	....	90.0	....	1,633
Bread, pastry, etc.;							
White bread	....	35.3	9.2	1.3	53.1	1.1	1,183
Brown bread	....	43.6	5.4	1.8	47.1	2.1	1,025
Graham bread	....	35.7	8.9	1.8	52.1	1.5	1,179
Whole-wheat bread	....	38.4	9.7	.9	49.7	1.3	1,114
Rye bread	....	35.7	9.0	.6	53.2	1.5	1,153
Cake	....	19.9	6.3	9.0	63.3	1.5	1,626
Cream crackers	....	6.8	9.7	12.1	69.7	1.7	1,929
Oyster crackers	....	4.8	11.3	10.5	70.5	2.9	1,908
Soda crackers	....	5.9	9.8	9.1	73.1	2.1	1,872
Sugars, etc.:							
Molasses	....	25.1	2.4	....	69.3	3.2	1,301
Candy	....	....	....	....	96.0	....	1,742
Honey[c]	....	18.2	.4	....	81.2	.2	1,481
Sugar, granulated	....	....	....	....	100.0	....	1,814
Maple sirup	....	....	....	....	71.4	....	1,295
Vegetables:[d]							
Beans, dried	....	12.6	22.5	1.8	59.6	3.5	1,562
Beans, Lima, shelled	....	68.5	7.1	.7	22.0	1.7	556
Beans, string	7.0	83.0	2.1	.3	6.9	.7	175
Beets	20.0	70.0	1.3	.1	7.7	.9	167
Cabbage	15.0	77.7	1.4	.2	4.8	.9	121
Celery	20.0	75.6	.9	.1	2.6	.8	68
Corn, green (sweet), edible portion	....	75.4	3.1	1.1	19.7	.7	458
Cucumbers	15.0	81.1	.7	.2	2.6	.4	68
Lettuce	15.0	80.5	1.0	.2	2.5	.8	72
Mushrooms	....	88.1	3.5	.4	6.8	1.2	203
Onions	10.0	78.9	1.4	.3	8.9	.5	199
Parsnips	20.0	66.4	1.3	.4	10.8	1.1	236
Peas (*Pisum sativum*), dried	....	9.5	24.6	1.0	62.0	2.9	1,612

[a] Refuse, oil.

[b] Refuse, shell.

[c] Contained on an average cane sugar 2.8 and reducing sugar 71.1 per cent. The reducing sugar was composed of about equal amounts of glucose (dextrose) and fruit sugar (levulose).

[d] Such vegetables as potatoes, squash, beets, etc., have a certain amount of inedible material—skin, seeds, etc. The amount varies with the method of preparing the vegetables, and can not be accurately estimated. The figures given for refuse of vegetables, fruits, etc., are assumed to represent approximately the amount of refuse in these foods as ordinarily prepared.

Average composition of American food products—Continued.

Food materials (as purchased).	Refuse.	Water.	Protein.	Fat.	Carbohydrates.	Ash.	Fuel value per pound.
VEGETABLE FOOD—continued.							
Vegetables [a]—Continued.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Cals.*
Peas (*Pisum sativum*) shelled	....	74.6	7.0	0.5	16.9	1.0	454
Cowpeas, dried	....	13.0	21.4	1.4	60.8	3.4	1,548
Potatoes	20.0	62.6	1.8	.1	14.7	.8	303
Rhubarb	40.0	56.6	.4	.4	2.2	.4	63
Sweet potatoes	20.0	55.2	1.4	.6	21.9	.9	448
Spinach	....	92.3	2.1	.3	3.2	2.1	108
Squash	50.0	44.2	.7	.2	4.5	.4	102
Tomatoes	....	94.3	.9	.4	3.9	.5	103
Turnips	30.0	62.7	.9	.1	5.7	.6	124
Vegetables, canned:							
Peas (*Pisum sativum*), green	....	85.3	3.6	.2	9.8	1.1	251
Corn, green	....	76.1	2.8	1.2	19.0	.9	444
Tomatoes	....	94.0	1.2	.2	4.0	.6	102
Fruits, berries, etc., fresh: [b]							
Apples	25.0	63.3	.3	.3	10.8	.3	214
Bananas	35.0	48.9	.8	.4	14.3	.6	290
Grapes	25.0	58.0	1.0	1.2	14.4	.4	328
Lemons	30.0	62.5	.7	.5	5.9	.4	140
Muskmelons	50.0	44.8	.3	....	4.6	.3	89
Oranges	27.0	63.4	.6	.1	8.5	.4	169
Pears	10.0	76.0	.5	.4	12.7	.4	256
Persimmons, edible portion	....	66.1	.8	.7	31.5	.9	614
Raspberries	....	85.8	1.0	....	12.6	.6	247
Strawberries	5.0	85.9	.9	.6	7.0	.6	168
Watermelons	59.4	37.5	.2	.1	2.7	.1	57
Fruits, dried:							
Apples	....	28.1	1.6	2.2	66.1	2.0	1,317
Apricots	....	81.4	.9	....	17.3	.4	330
Dates	10.0	13.8	1.9	2.5	70.6	1.2	1,416
Figs	....	18.8	4.3	.3	74.2	2.4	1,436
Nuts:							
Almonds	45.0	2.7	11.5	30.2	9.5	1.1	1,600
Beechnuts	40.8	2.3	13.0	34.0	7.8	2.1	1,750
Brazil nuts	49.6	2.6	8.6	33.7	3.5	2.0	1,580
Butternuts	86.4	.6	3.8	8.3	.5	.4	413
Chestnuts, fresh	16.0	37.8	5.2	4.5	35.4	1.1	918
Chestnuts, dried	24.0	4.5	8.1	5.3	56.4	1.7	1,384
Cocoanuts	[c] 48.8	7.2	2.9	25.9	14.3	.9	1,358
Cocoanut, prepared	....	3.5	6.3	57.4	31.5	1.3	3,003
Filberts	52.1	1.8	7.5	31.3	6.2	1.1	1,512
Hickory nuts	62.2	1.4	5.8	25.5	4.3	.8	1,213
Pecans, polished	53.2	1.4	5.2	33.3	6.2	.7	1,551
Peanuts	24.5	6.9	19.5	29.1	18.5	1.5	1,864
Piñon (*Pinus edulis*)	40.6	2.0	8.7	36.8	10.2	1.7	1,829
Walnuts, California, black	74.1	.6	7.2	14.6	3.0	.5	774
Walnuts, California, soft-shell	58.1	1.0	6.9	26.6	6.8	.6	1,322
Raisins	10.0	13.1	2.3	3.0	68.5	3.1	1,406
Miscellaneous:							
Chocolate	....	5.9	12.9	48.7	30.3	2.2	2,750
Cocoa, powdered	....	4.6	21.6	28.9	37.7	7.2	2,242
Cereal coffee infusion (1 part boiled in 20 parts water) [d]	....	98.2	.2	....	1.4	.2	29

[a] Such vegetables as potatoes, squash, beets, etc., have a certain amount of inedible material—skin, seeds, etc. The amount varies with the method of preparing the vegetables, and can not be accurately estimated. The figures given for refuse of vegetables, fruits, etc., are assumed to represent approximately the amount of refuse in these foods as ordinarily prepared.

[b] Fruits contain a certain proportion of inedible material, as skin, seeds, etc., which are properly classed as refuse. In some fruits, as oranges and prunes, the amount rejected in eating is practically the same as refuse. In others, as apples and pears, more or less of the edible material is ordinarily rejected with the skin and seeds and other inedible portions. The edible material which is thus thrown away, and which should properly be classed with the waste, is here classed with the refuse. The figures for refuse here given represent, as nearly as can be ascertained, the quantities ordinarily rejected.

[c] Milk and shell.

[d] The average of five analyses of cereal coffee grain is: Water 6.2, protein 13.3, fat 3.4, carbohydrates 72.6, and ash 4.5 per cent. Only a portion of the nutrients, however, enter into the infusion. The average in the table represents the available nutrients in the beverage. Infusions of genuine coffee and of tea like the above contain practically no nutrients.

DIETARY STANDARDS.

Dietary studies have been made in considerable numbers in different countries. The results of such studies and of experiments to determine the amount of food required by men engaged in different occupations have resulted in the adoption of dietary standards. Some of these follow:

Standards for daily dietaries.

Character of work to be performed.	Nutrients.			Fuel value.
	Protein.	Fat.	Carbohydrates.	
European:	*Pound.*	*Pound.*	*Pounds.*	*Calories.*
Man at moderate work	0.26	0.12	1.10	2,695
Man at hard work	.32	.22	.99	3,270
American:				
Man without muscular work	.20			2,450
Man with light muscular (sedentary) work	.22			2,700
Man with light to moderate muscular work	.25			3,050
Man with moderate muscular work	.28			3,400
Man with very hard muscular work	.39			5,500

The table of composition of food materials shows the amount of water, protein, fat, carbohydrates, and ash and the total fuel value per pound for each kind of food named. The protein, fat, and carbohydrates all furnish energy. In addition to furnishing energy, protein forms tissue. Since protein and energy are the essential features of food, dietary standards may be expressed in their simplest form in terms of protein and energy alone.

Observation has shown that as a rule a woman requires less food than a man, and the amount required by children is still less, varying with the age. It is customary to assign certain factors which shall represent the amount of nutrients required by children of different ages and by women as compared with adult man. The various factors which have been adopted are as follows:

Factors used in calculating meals consumed in dietary studies.

Man at hard muscular work requires 1.2 the food of a man at moderately active muscular work.

Man with light muscular work and boy 15–16 years old require 0.9 the food of a man at moderately active muscular work.

Man at sedentary occupation, woman at moderately active work, boy 13–14, and girl 15–16 years old require 0.8 the food of a man at moderately active muscular work.

Woman at light work, boy 12, and girl 13–14 years old require 0.7 the food of a man at moderately active muscular work.

Boy 10–11 and girl 10–12 years old require 0.6 the food of a man at moderately active muscular work.

Child 6–9 years old requires 0.5 the food of a man at moderately active muscular work.

Child 2–5 years old requires 0.4 the food of a man at moderately active muscular work.

Child under 2 years old requires 0.3 the food of a man at moderately active muscular work.

These factors are based in part upon experimental data and in part upon arbitrary assumptions. They are subject to revision when experimental evidence shall warrant more definite conclusions.

METHOD OF MAKING DIETARY STUDIES.

The plan followed in making dietary studies is, briefly, as follows: Exact account is taken of all the food materials (1) on hand at the beginning of the study, (2) purchased during its progress, and (3) remaining at the end. The difference between the third and the sum of the first and second is taken as representing the amount used. From the figures thus obtained for the total quantities of the different food materials the amounts of the different nutrients and the energy furnished by them are calculated. Deducting from these values the nutrients and energy found in the kitchen and table refuse, the amounts actually consumed are obtained. Account is also taken of the meals eaten by different members of the family or group studied and by visitors, if there are any. From the total food eaten by all the persons during the entire period the amount eaten per man per day may be calculated. In making these calculations due account is taken of the fact that, as stated above, women and children eat less than men performing the same amount of work.

METHOD OF CALCULATING DIETARIES.

The following may be taken as an illustration of the way in which the table of composition of food products and the dietary standards may be practically applied. Suppose the family consists of four adults engaged in moderate muscular work, and that there are on hand or may be readily purchased the following food materials: Oatmeal, milk, sugar, eggs, lamb chops, roast beef, potatoes, sweet potatoes, rice, bread, cake, bananas, tea, and coffee. From these materials menus for three meals might be arranged as follows:

Breakfast.—Oatmeal, milk, sugar, lamb chops, bread, butter, and coffee.

Dinner.—Roast beef, potatoes (Irish), sweet potatoes, rice pudding, and tea.

Supper.—Bread, butter, cake, and bananas.

The amounts required of the several articles of food may be readily approximated by any person experienced in marketing or preparing food for a family. Thus, it may be assumed that four adults engaged in moderate muscular work would consume for breakfast 1.5 pounds lamb chops, one-half pound oatmeal, one-half pound bread, 6 ounces milk, 3 ounces sugar, and 2 onnces butter. From the table of composition of food materials the nutritive ingredients which these foods furnish may be easily calculated. Thus, if oatmeal contains 16.1 per cent of protein and furnishes 1,808 calories per pound, one-half pound

would contain 0.081 pound protein (0.5 × 0.161 = 0.081 pound) and yield 930 calories (0.5 × 1,808 = 904), and if lamb chops contain 16 per cent protein and furnish 1,086 calories per pound, 1.5 pounds of lamb chops would furnish 0.24 pound protein (1.5 pounds × 0.16 = 0.24 pound) and 1,695 calories (1.5 pounds × 1,086 = 1,629 calories). The others may be calculated in the same way.

The assumed quantities of food materials which the four persons would consume in a day, and the calculated protein content and fuel value, would be as follows:

Menu for family of four adults for one day.

[Standard: Man at moderate muscular work.]

Food materials.	Weights.		Protein.	Fuel value.
BREAKFAST.				
Oatmeal:	*Pounds.*	*Ounces.*	*Pound.*	*Calories.*
Oatmeal		8	0.081	904
Milk		6	.012	117
Sugar		3		340
Lamb chops (from leg)	1	8	.240	1,629
Bread		8	.046	592
Butter		2	.001	431
Coffee [a]			.010	381
Total			.390	4,394
DINNER.				
Roast beef (chuck)	1	12	.277	1,384
Potatoes	1		.018	303
Sweet potatoes		12	.011	335
Bread		6	.035	444
Butter		2	.001	431
Rice pudding:				
Rice		4	.020	398
Eggs		4	.033	153
Milk		6	.012	117
Sugar		3		340
Tea			.010	381
Total			.417	4,286
SUPPER.				
Bread		12	.069	887
Butter		3	.002	647
Bananas		12	.006	218
Cake		8	.032	813
Total			.109	2,565
Total for 3 meals			.916	11,245
Average for 1 person			.229	2,811

[a] Coffee and tea in themselves have little or no nutritive value. In the menu, allowance is made for the milk or cream and the sugar that would ordinarily be added.

The American dietary standard for a man at moderate muscular work calls for 0.28 pound protein and 3,400 calories of energy. It will be seen that the menu suggested above is insufficient—that is, that more food must be supplied. For instance, cheese might be added for dinner, and pork and beans for supper. The amounts of protein and energy which a sufficient quantity of these articles for four persons would supply are shown in the table following.

Food added to bring the day's menu up to the dietary standard.

Food materials.	Weight.	Protein.	Fuel value.
	Ounces.	*Pound.*	*Calories.*
Cheese	4	0.065	469
Beans	10	.141	976
Pork	4	.005	879
Total amount added to menu		.211	2,324

These additions would make the total protein 1.127 pounds and the total fuel value 13,569 calories for four persons, or for one person, 0.282 pound protein and 3,392 calories. (For the sake of simplifying the calculations no distinction is made between the amounts required by men and women.) These values are approximately the amounts required by the dietary standard.

Following the above method, the value of any menu chosen may be easily calculated. It should be borne in mind that approximate rather than absolute agreement with the dietary standard is sought. It is not the purpose to furnish a prescription for definite amounts of food materials, but rather to supply the means of judging whether the food habits of families accord in general with what research has shown to be most desirable from a physiological standpoint. If economy is necessary, a study of the tables will show that it is possible to devise menus which will furnish the requisite amounts of nutrients and energy at comparatively low cost.

DIGESTIBILITY.

The value of a food is determined not alone by its composition, but also by its digestibility—that is, by the amount of it which the body can retain and utilize as it passes through the digestive tract. The term digestibility, as frequently employed, particularly in popular articles, has several other significations. Thus, to many persons it conveys the idea that a particular food "agrees" with the user—i. e., that it does not cause distress when eaten. The term is also very commonly understood to imply ease or rapidity of digestion, and one food is often said to be more digestible than another because it is digested in less time. However, the term digestibility is most commonly understood in scientific treatises on the subject to mean thoroughness of digestion. The digestibility of any food may be learned most satisfactorily by experiments with man, although experiments are also made by methods of artificial digestion. In the experiments with man the food, feces, and urine are generally analyzed. The amounts of fat and carbohydrates digested are then determined by deducting the amounts of each excreted in the feces from the amounts of each taken into the body in the food. Since it has been found that

the urine as well as the feces contain undigested protein, the amount of protein digested is found by deducting from the protein of the food consumed, that in the feces plus that of the urine, which latter is, if not actually determined, found by use of certain factors. The results are usually expressed in percentages and spoken of as coefficients of digestibility. From a large number of experiments with man it has been calculated that on an average the different groups into which foods may for convenience be divided have the following coefficients of digestibility:

Coefficients of digestibility of different groups of food.

	Protein.	Fat.	Carbohydrates.
	Per cent.	*Per cent.*	*Per cent.*
Animal foods	97	95	98
Cereals	85	90	98
Legumes, dried	78	90	97
Sugars and starches			98
Vegetables	83	90	95
Fruits	85	90	90
Vegetable foods	84	90	97
Total food	92	95	97

Making use of these figures, the digestible nutrients furnished by any food may be readily calculated. Thus, as shown by the table of composition above, sirloin steak contains 16.5 per cent protein. One and one-half pounds would therefore contain 0.2475 pound protein, or in round numbers, 0.25 pound ($1.5\times0.165=0.2475$). As shown by the coefficients of digestibility quoted above, 97 per cent of the protein of animal food is digestible. Therefore, 1.5 pounds sirloin steak would furnish 0.243 pound digestible protein ($0.25\times0.97=0.243$). The digestibility of the several nutrients in a given quantity of any food may be calculated in a similar way.

Recommended for publication.

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Approved:

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